Technical Review

To:	Otago Regional Council (ORC)	**Date:**	29/10/2026
Authority:	ORC	**Ref:**	RM25.407.01
Consent:	RM25.407.01 _SJ Allen Holdings		

From	**Role in Audit**	**Internal Reviewer**
Nicole Freeman	Hydrology review	Simon Bloomberg

1 Project Summary

SJ Allen holds discharge permit RM25.407.01 to apply waste products to land at a site in Lauder. The waste products include Waste Activated Sludge (WAS) from the Wanaka Wastewater Treatment Plant (WWTP), winery wastewater and grease trap and mud sump wastewater. The Otago Regional Council (ORC) are investigating whether to undertake a review of the consent conditions under s.128 of the RMA 1991. e3 Scientific (e3s) were engaged to review the application, consent conditions and associated documents to determine if the consent conditions were suitable to avoid, remedy or mitigate adverse effects on the environment with a particular focus on groundwater quality and a down-gradient water take.

Information reviewed in the preparation of this assessment includes:

- Consent application, Lowe Environmental Impact
- Operations and Management Manual technical audit, Babbage Consultants Limited
- Consent Notification Recommendation Report, Otago Regional Council
- Operations and Management Manual, SJ Allen Holdings Ltd
- Response to RFI, Lowe Environmental Impact
- Discharge Permit RM25.407.01
- Water quality results, baseline and post-discharge sampling.

A site visit was carried out on the 16th October alongside Keri Johnstone from Irricon and ORC staff. At the site visit uncertainty was raised regarding the end use of the permitted water take at [redacted] As no additional clarification was available at the time of writing it is conservatively assumed that this permitted water take could be used for potable supply when considering potential groundwater quality risks. It is noted that the baseline water quality results at BH-002 (upgradient of the permitted water take) exceeded the drinking water standard for *E. coli* on the 4th May 2026. The drinking water standards have not been applied when discussing water quality at BH-002 but have been when discussing pathogen reduction rates and application setbacks from the permitted water take.

At the site visit the site manager indicated that Public Health and Forensic (PHF) Science was imminently visiting the site to undertake additional soil and groundwater analysis including completing the installation of the up-gradient groundwater monitoring bore. It is likely these investigations by PHF Science will answer several of the questions and areas of concern raised in this review.

The information reviewed alongside the consent conditions suggests that the potential effects on groundwater and the down-gradient water take are not fully understood. Additionally, the current groundwater monitoring programme requires two extra monitoring bores and the soil sampling programme requires sampling at depths down the soil profile to accurately determine effects of the activity on the environment.

Note: This response is to be read alongside the response from Keri Johnstone of Irricon who focuses on the nitrogen application rates, crop uptake, runoff and sensitive receptors.

2 Audit Questions

Is it practicable for the activity to be undertaken in accordance with conditions 1 – 10 and the OMM?

It is practicable for the activity to be undertaken in accordance with the consent conditions and the OMM except for the points that were raised in the technical audit by Babbage Consultants and the proposed soil sampling from below the grease trap and mud sump trenches.

- The audit of the OMM by Babbage Consultants raised a few points regarding waste application conditions which required further clarification to allow practical implementation. The review also raises that it is not practical to compare groundwater monitoring results to the baseline samples collected prior to discharge. At the time of the site visit an up-gradient bore was being installed, the location shown in Figure 1, going forward down-gradient samples can be compared to results from this location to determine the effect of the discharge on groundwater quality. Furthermore, surface water monitoring locations may not always be flowing, and contingencies should be provided for when surface water monitoring sites are dry.
- In addition, it is not practical for soil sampling to occur from the base of the grease trap and mud sump trenches. The purpose of soil sampling is to determine the movement of contaminants in grease trap and mud sump material into the soil below the trenches. It is not clear how this will be achieved when the trenches contain grease trap/ mud sump waste without contaminating the soil sample. Applying grease trap and mud sump waste via soil injection was also discussed in the application, and this, or an alternate method, would be preferable, to enable monitoring of contaminant migration through the soil profile while maintaining adequate separation from groundwater.

Do the current measures reflected in conditions 2 – 10 and the OMM adequately avoid, remedy or mitigate the actual or potential adverse effects of the activity on the environment as described in the Application? If not, what other measures are required?

Because the actual or potential adverse effects on the environment do not appear to be accurately understood or described in the application the conditions and the OMM do not adequately avoid, remedy or mitigate them. The measures listed below are required to understand the full effects of the activity and to implement measures to mitigate them:

- Testing of the WAS for viruses such as Norovirus should be undertaken or provided to determine the loading of these viruses. Without this information the adequacy of setback distances for viral pathogen attenuation remains uncertain. While secondary treatment for activated sludges can remove 90% of protozoa and helminths, viruses are reported to be accumulated into the sludge (NZLTC, 2000). Viruses typically have a lower rate of

reduction than other pathogens in soil due to two main factors (NZLTC, 2000):

  - Lower rate of adsorption to soil because virus particles have a negative charge when pH is above neutral (potentially in WAS) meaning they are repulsed from the negative charge of soil particles.
  - Lower rate of filtration by soil because viruses are smaller than bacteria and protozoa.

- The application has noted a reduction rate in *E. coli* concentrations of 6.7 log/m of soil depth however there is no direct reference provided for this number. In research from ESR log reductions are provided for different soil types (Leonard & Pang, 2006). From the test pitting the soils appear to be a mix of clay and silt loams in the topsoil with elevated concentrations of gravel in the B and C horizons. The closest representative bore log, a bore located 4 km SE of the site, suggests that alluvial deposits are present to a depth of 6 m overlying mudstone. At the time of the site visit a hole, extending to groundwater, had been dug at the northern property boundary for the installation of an up-gradient bore (location shown in Figure 1 and soil profile shown in Figure 4). The soil profile revealed by this hole was a thin topsoil of silt loam followed by gravelly silt, extending to groundwater. Similarly, a soil profile was observed through a hole excavated for the disposal of rubbish at the southern end of the Year 1 WAS application area. The soil profile at this location was similar, a thin topsoil of silt loam overlying gravelly silt, groundwater was not observed at this location, Figure 3. *E. coli* reductions vary based on soil type. For gravels, with no preferential flow paths, reductions are 1.3 log/m while a silty clay loam ranges from 0.49-3.5 log/m. The water levels measured in the groundwater bores installed on the site, BH-001 and BH-002, during baseline sampling in May 2026 were 3.3 – 4.2 m and 2.8 m respectively. The calculations in the table below were carried out assuming a 3 m soil depth and a mix of silty clay loams and gravels (using the combined mean reduction rates for the two mediums).

  It was also assumed that water quality at the permitted water take at [redacted] needs to meet drinking water standards (<1 MPN/100 mL). Preliminary calculations based on currently available site information suggest that a setback potentially greater than 200 m may be required to adequately protect groundwater quality. Further site-specific assessment should be undertaken before a definitive setback distance is established.

Location	*E. coli* (MPN/100 mL)
Waste Activated Sludge	650000
At 1 m soil depth	25728
At 2 m soil depth	1018
At 3 m soil depth	40
Probability of exceeding 5/L* at 200 m setback (PHF Science, 2026)	23%
Probability at 300 m setback	5%
Probability at 400 m setback	<1%

*The MRA tool developed by PHF science calculates the maximum acceptable concentration for *E. coli* from the drinking water standard of <1 MPN/100 mL set by the Ministry of Health.

- Both the WAS and winery wastewater contain elevated concentrations of nitrogen and given the proposed application rate of nitrogen in WAS (600 kg N/ha every 3 years) this could result in elevated nitrogen in groundwater. While nitrogen in the WAS is mainly organic nitrogen, nitrification in the soil will result in conversion to nitrate nitrogen which is susceptible to leaching into groundwater. The application rate of nitrogen is to be adjusted in accordance with the recommendations of Keri Johnstone from Irricon. Two additional down-gradient monitoring bores are proposed (Figure 1). Groundwater monitoring, including water level monitoring, on a quarterly basis of the existing two down-gradient bores, up-gradient bore under installation, and the two additional proposed down-gradient bores, is recommended. All bores should also be surveyed so that they groundwater flow direction can be confirmed. So far four groundwater sampling rounds have been carried out, two baseline samples, prior to discharge commencing, and two samples post-discharge commencing. All results show that nitrate nitrogen is present in groundwater and is elevated in BH-001 above BH-002. Without results from an up-gradient bore it is not possible to attribute the increase in nitrate nitrogen or other analytes at BH-001 or BH-002 to the discharge activity. Assessment criteria are discussed in the following sections.

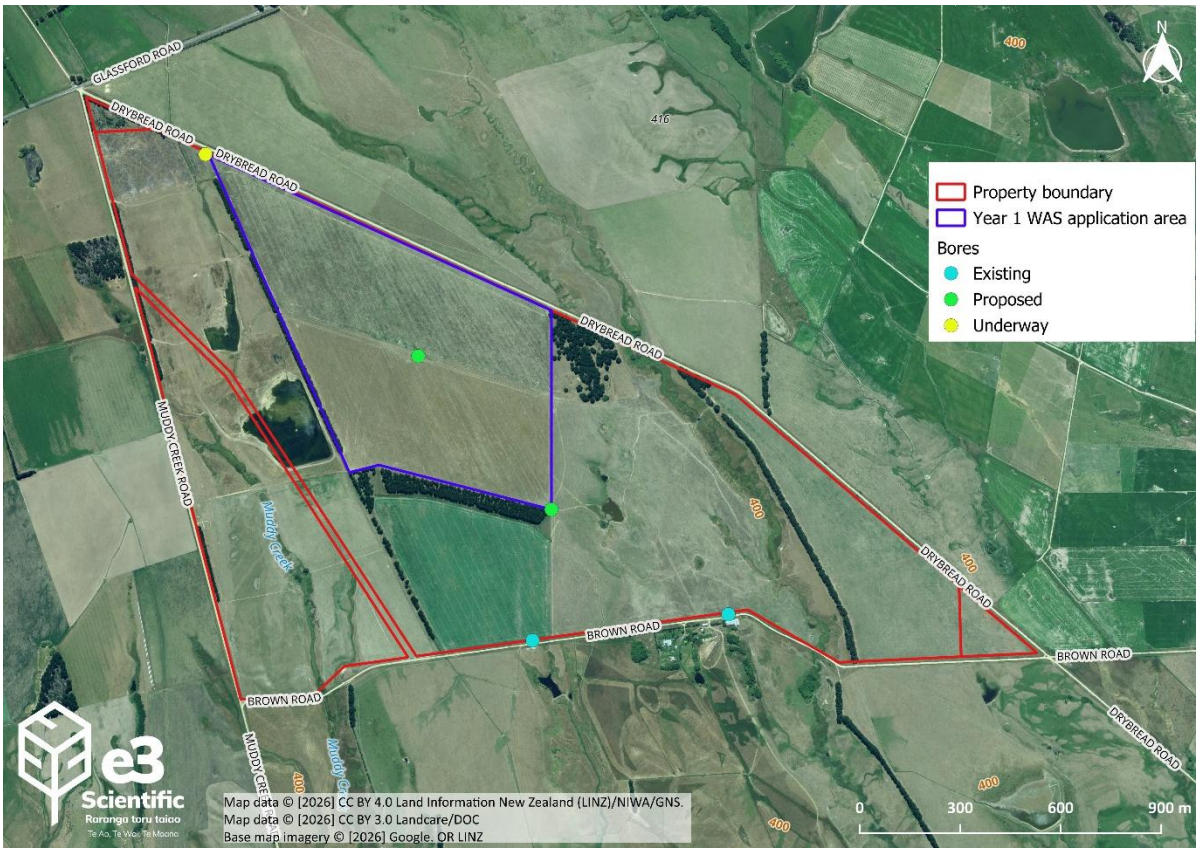


Figure 1: Existing and proposed groundwater monitoring bores

- Testing of the biological loading rate in the routine winery wastewater and the grease trap and mud sump sludge is required to determine if the soil can process these rates of application. A rate of 600 kg/ha.day or 0.06 kg/m^2.day is generally acceptable for application via irrigation or rapid infiltration systems (Robb & Barkle, 2000). The assessment indicates that biological loading rates may exceed commonly accepted design criteria under some operating scenarios and should be reviewed against the proposed application regime.

	Daily winery wastewater application
Volume (m^3)	20
Area (m^2)	1800
$CBOD_5$ g/m^3	7229
Daily $CBOD_5$ (kg)	144.58
Daily $CBOD_5$ (kg/m^2)	0.08

- The proposed setback from the application of WAS to the domestic water take is 200 m and is proposed to be removed after 5 years. From the *E. coli*

reduction rates stated above this setback area would be insufficient to protect the domestic water take. Additionally, the concentration of viruses in the WAS and therefore required setbacks are unknown. Additional investigations are recommended to confirm the soil type and depth to groundwater across the site alongside virus concentrations to accurately calculate virus and *E. coli* reduction rates. This would then determine the adequacy of the current WAS setback distances for pathogen attenuation.

- The soil monitoring proposed for the grease trap and mud sump trenches does not appear practical. Instead, alternate methods (such as soil injection) should be investigated that enable monitoring of contaminant migration through the soil profile. The application method should also ensure separation from groundwater, given the lack of information around the variability in groundwater across a year and would reduce the risk of water pooling in trenches during/following rain events.
- Soil monitoring proposed for WAS and winery wastewater application areas should also be carried out at increasing depths down the soil profile to determine the migration of contaminants. To achieve this composite samples are still recommended however representing three different depth layers: 0-200 mm, 300-500 mm and 800-1000 mm. Visual soil assessments are also recommended to accompany the soil sampling. Soil testing parameters should include those listed in consent condition 7 for the WAS area as well as the following parameters which should also be carried out across the winery wastewater application area:
    - Exchangeable cations (sodium, potassium, magnesium, calcium);
    - Cation Exchange Capacity (CEC);
    - Base saturation & base cations;
    - pH;
    - Total carbon;
    - Total nitrogen and available nitrogen;
    - Total phosphorus and Olsen P;
    - Exchangeable Sodium Percentage (ESP).
- The high concentration of sodium in the winery wastewater could result in dispersion of the soil. Prior to winery wastewater discharge commencing the soil should be tested for susceptibility of soil aggregates to dispersion using a soil dispersion test such as that described in the AS/NZS 1547. Soil ESP and CEC should also be measured prior to application. ESP and CEC should be measured again at annual testing throughout application of winery wastewater to identify increases in exchangeable sodium

attributable to wastewater application. Additional soil dispersion tests could be carried out during annual soil sampling if ESP is found to be increasing or VSAs identify deteriorating soil structure.

- The sampling programme described for the first 12 months should be continued, at the same frequency, for the first 5 years of application and be reviewed following this.

Do the current measures reflected in conditions 2 – 10 and the OMM adequately avoid, remedy or mitigate the actual or potential adverse effects of the activity on the nearby permitted water take at [redacted]? If not, what other measures are required?

No.

- Installation of an additional 2 down-gradient groundwater monitoring bores is required, as per Figure 1. Bore logs and information on screening interval are required, all bores, including the two existing bores, need to be developed.
- As explained above testing or reporting of virus concentrations in the WAS needs to be carried out alongside calculations on the expected reduction in these concentrations to determine the adequacy of proposed setback distances for the application of WAS from the permitted water take at [redacted]. This setback distance would be permanent, not reduced or removed after 5 years, and would be included in consent condition 6.
- Accurately calculate the reduction rate of *E. coli* through depth to water and distance to source (permitted water take at [redacted]). To inform this the soil type as it falls within the categories listed by Leonard & Pang (2006) and the depth to water across the site need to be more accurately assessed to determine if both are sufficient for pathogen reduction. Groundwater level would then need to be monitored across the year to ensure that adequate depth to groundwater was maintained.
- Permanent setback between the application of WAS and the permitted water take would be required.
- Application of WAS should not occur when groundwater levels are elevated above those required for the reduction of *E. coli* or other pathogens (ie., the 3 m calculated in the table above). To ensure this setback continuous groundwater level monitoring should be carried out in the groundwater bores to understand changes over the year as well as at other locations within the WAS application zones. Groundwater level indicators or telemetered piezos could be used within the WAS application

zones to provide a visual indicator of whether groundwater levels were acceptable for application to take place.

- Groundwater monitoring, including water level monitoring, of all bores is required quarterly. To assess the impact of the application on groundwater, water quality results should be reviewed to determine if contaminant concentrations in down-gradient bores indicate an increasing trend[1] relative to the up-gradient bore after collection of 8-10 bi-monthly or quarterly samples (EPA, 2024). This is the minimum number of samples required to estimate target population medians with relatively good precision; additional samples are required to estimate a wider range of percentiles. While there is insufficient baseline data to inform pre-discharge water quality it is still important to ensure protection of groundwater quality prior to trends being developed. A review of all up and down-gradient water quality results (surface and groundwater) alongside groundwater flow direction and the land application completed is recommended if:
    - Nitrate levels in down-gradient bores exceed half of maximum acceptable value (MAV) for drinking water (Taumata Arowai, 2024).
    - *E. coli* is detected in any down-gradient bore.

Are current monitoring conditions (Conditions 11 – 26) adequate to accurately monitor the actual or potential adverse effects of the activity on the environment, including groundwater generally, and the nearby permitted water take at [redacted]

No. The following would need to be added to the consent conditions 11-26 to ensure protection of groundwater and the permitted water take at [redacted]:

- At least one routine WAS test annually to also include testing for *E. coli* and virus concentrations including Norovirus.
- An alternate method for the application of grease trap and mud sump waste should be investigated (such as soil injection). Soil sampling of the

[1] A trend assessment can be carried out using the Mann-Kendall or other established method.

application area should be carried out annually with composite samples from three depths down the soil profile: 0-200 mm, 300-500 mm and 800-1000 mm. Soil sampling should also include at least one VSA across the discharge area.

- Include testing of $cBOD_5$ for winery wastewater and grease trap and mud sump waste.
- Soil testing of the WAS and winery wastewater application areas should be carried out annually with composite samples from three depths down the soil profile: 0-200 mm, 300-500 mm and 800-1000 mm. Soil sampling should be carried out across the area of which WAS and winery wastewater had been applied that year as well as over the areas applied in previous years. There should be at least one VSA in each WAS application zone and one in the winery wastewater application area.
- Two additional down-gradient groundwater monitoring bores in the middle of the property. Bore logs are to be submitted to provide details on the underlying soil and aquifer, and the screening interval must be recorded.
- All bores to be surveyed to determine the direction of groundwater flow.
- Develop the existing monitoring bores.
- Quarterly monitoring, including water level monitoring, of all groundwater monitoring bores with trends calculated after the collection of 8-10 samples to assess if there is an increasing trend in down-gradient bores relative to the up-gradient bore.
- In the interim, prior to calculating trends, a review of water quality data, groundwater flow direction and land application to be undertaken if:
    - Nitrate levels in down-gradient bores exceed half of MAV.
    - *E. coli* is detected in any down-gradient bore.

Would any mitigation measures detailed in the approved OMM be more appropriate as conditions of the consent?

Yes. While the process for implementing mitigation measures can be included in the OMM, the following would be required in consent conditions to ensure protection of groundwater and the permitted water take:

- Soil depth required (depth to groundwater) to ensure pathogen reduction.
- Setback distance between application of WAS and permitted water take to ensure pathogen reduction.
- Location of groundwater level monitoring to ensure depth to groundwater is maintained.

- Location of groundwater quality monitoring and the methodology for assessing any declining trends in groundwater quality relative to the up-gradient bore.
- Number of composite soil samples and VSAs required for each application area and depth horizons for sampling.

Are additional measures needed for the water race, is a hardstand required for depositing WAS before spreading and does the OMM adequately address land steeper than 15 degrees?

Keri Johnstone from Irricon has responded to the requirement for additional measures relating to the water race running through the property and the application of WAS on land steeper than 15 degrees.

A hardstand area for the deposition of WAS prior to application to land could be used to reduce the concentrations of pathogens and nitrogen in the WAS. Liquid runoff from the hardstand would need to be captured because this would have a high nitrogen concentration. The need for additional pathogen reduction will be informed by testing the WAS for viruses, clarification on depth to groundwater across the disposal area and soil type across the disposal area. These factors will allow pathogen reduction to be accurately calculated and alongside this the required setback for application of WAS from the permitted water take. It may be that treatment of WAS on a hardstand is required prior to application to land to ensure acceptable pathogen levels are achieved at the down-gradient water take.

3 Key Recommendations

- Strengthen pathogen monitoring: Require annual testing of waste activated sludge (WAS) for relevant pathogens, including viruses such as norovirus, to better understand potential risks to groundwater and down-gradient water take.
- Improve groundwater monitoring: Install two additional down-gradient monitoring bores, with bore logs and screened intervals documented.
- Monitor groundwater levels: Implement continuous groundwater level monitoring to establish seasonal fluctuations and confirm the available separation between the land application area and groundwater.
- Increase groundwater quality monitoring: Undertake quarterly groundwater monitoring, including *E. coli* and nitrate-nitrogen. Assess trends after collection of 8-10 samples to determine if down-gradient results are increasing relative to up-gradient results.
- In the absence of sufficient baseline data, to ensure the protection of water quality at the permitted water take and in downgradient groundwater, undertake a review of available water quality data, groundwater flow direction and land application if:
    - Nitrate levels in down-gradient bores exceed half of MAV.
    - *E. coli* is detected in any down-gradient bore.
- Manage organic loading: Carry out testing of $CBOD_5$ on winery wastewater and grease trap and mud sump sludge and review application rates against the proposed soil loading criteria to determine the potential for excessive organic loading.
- Improve soil monitoring: Undertake annual soil monitoring using composite samples collected at multiple depths (0–200 mm, 300–500 mm and 800–1000 mm). Include relevant indicators such as sodium-related soil impacts for the winery wastewater application area and VSAs across all discharge areas.
- Review pathogen attenuation and setbacks: Reassess the proposed 200 m setback from domestic water takes using site-specific soil characteristics, depth to groundwater and verified pathogen attenuation rates. Establish a permanent setback that adequately protects groundwater and down-gradient water users.
- Manage high groundwater conditions: Establish clear requirements to suspend WAS application when groundwater levels do not provide the required depth to groundwater to achieve pathogen reductions.

- Review wastewater application methods: Consider an alternate method for grease trap and mud sump wastewater disposal (such as soil injection) to allow for soil testing which assesses the migration of contaminants through the soil profile.
- Incorporate safeguards into consent conditions rather than relying on the OMM.

4 Site Visit Observations

At the site visit on the 16th October groundwater monitoring was carried out at BH-001 and BH-002 using a low flow method. From the baseline monitoring notes it appeared that the bores had not been developed because sediment loads had been observed during sampling. Low flow rate sampling is carried out using a pump, monitoring groundwater level and altering pump rate to reduce drawdown in the bore while monitoring physical parameters such as dissolved oxygen, electrical conductivity and turbidity (NTU). Samples are collected once readings of physical parameters have stabilised. This ensures that the water being sampled is groundwater flowing through the screen rather than water sitting stagnant in the bore. Low turbidity values were recorded alongside stable readings for other physical parameters which suggests that the bores may be suitable as they are (without being developed) if a low flow sampling method is employed.



Figure 2: Existing groundwater monitoring bores BH-001 (right), BH-002 (left)

A soil profile was observed at two locations within the Year 1 WAS application area from pits that had been dug. At the southern end of the Year 1 WAS application area the soil profile of a rubbish hole shows a thin topsoil of silt loam overlying silty gravels with occasional cobble and boulder-sized material. The pit dug at the northern end of the Year 1 WAS application area, for the purpose of installing an up-gradient groundwater monitoring bore, showed a very similar soil profile with groundwater at the bottom of the pit.



Figure 3: Soil profile at southern end of Year 1 WAS application area.



Figure 4: Soil profile at location of the new up-gradient monitoring bore.

5 References

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